



**AFRL-SA-WP-SR-2018-0005**

# **United States Air Force Hearing Conservation Program, Annual Report for Calendar Year 2016**



**Elizabeth Anne S. McKenna, AuD, CPS/A;  
Daniel A. Williams, AuD, Maj, USAF, BSC**



**May 2018**

**DISTRIBUTION STATEMENT A. Approved for  
public release. Distribution is unlimited.**

**Air Force Research Laboratory  
711<sup>th</sup> Human Performance Wing  
U.S. Air Force School of Aerospace Medicine  
Public Health and Preventive Medicine Dept  
2510 Fifth St., Bldg. 840  
Wright-Patterson AFB, OH 45433-7913**

# NOTICE AND SIGNATURE PAGE

Using Government drawings, specifications, or other data included in this document for any purpose other than Government procurement does not in any way obligate the U.S. Government. The fact that the Government formulated or supplied the drawings, specifications, or other data does not license the holder or any other person or corporation or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

Qualified requestors may obtain copies of this report from the Defense Technical Information Center (DTIC) (<http://www.dtic.mil>).

AFRL-SA-WP-SR-2018-0005 HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION IN ACCORDANCE WITH ASSIGNED DISTRIBUTION STATEMENT.

//SIGNATURE//

---

LT COL PAULINE LUCAS  
Chief, Epidemiology Consult Service

//SIGNATURE//

---

COL JAMES R. POEL  
Chair, Public Health & Prev Med Dept

This report is published in the interest of scientific and technical information exchange, and its publication does not constitute the Government's approval or disapproval of its ideas or findings.

<b>REPORT DOCUMENTATION PAGE</b>				<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. <b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b>					
<b>1. REPORT DATE (DD-MM-YYYY)</b> 3 May 2018		<b>2. REPORT TYPE</b> Special Report		<b>3. DATES COVERED (From – To)</b> January – December 2016	
<b>4. TITLE AND SUBTITLE</b>  United States Air Force Hearing Conservation Program, Annual Report for Calendar Year 2016				<b>5a. CONTRACT NUMBER</b>	
				<b>5b. GRANT NUMBER</b>	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
<b>6. AUTHOR(S)</b>  Elizabeth Anne S. McKenna, Maj Daniel A. Williams				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
				<b>5f. WORK UNIT NUMBER</b>	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> USAF School of Aerospace Medicine Public Health & Preventive Medicine Dept/PHR 2510 Fifth St., Bldg. 840 Wright-Patterson AFB, OH 45433-7913				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>  AFRL-SA-WP-SR-2018-0005	
<b>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b>				<b>10. SPONSORING/MONITOR'S ACRONYM(S)</b>	
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>	
<b>12. DISTRIBUTION / AVAILABILITY STATEMENT</b>  DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b> Cleared, 88PA, Case # 2018-2750, 29 May 2018.					
<b>14. ABSTRACT</b> The U.S. Air Force School of Aerospace Medicine (USAFSAM), Epidemiology Consult Service Division, Operations Support Branch, Hearing Conservation Program (HCP) section prepares an annual status report on the USAF HCP in accordance with Air Force Instruction 48-127, <i>Occupational Noise and Hearing Conservation Program</i> , Section 2.9.2.17, and Department of Defense Instruction 6055.12, <i>Hearing Conservation Program</i> . This report covers calendar year 2016. The purpose of this report is to provide a corporate view of the status of the USAF HCP with data reported from the Defense Occupational and Environmental Health Readiness System-Hearing Conservation Data Repository (DOEHRS-HC DR). Major command- and installation-level reports are available quarterly and by request from USAFSAM Operations Support Branch, as well as by those who have user-defined roles in the Data Repository. This report covers information regarding software implementation status, HCP effectiveness metrics, to include an overview of a few standard reports currently available in the DOEHRS-HC DR database, and our recommendations.					
<b>15. SUBJECT TERMS</b> Hearing conservation, permanent threshold shift, significant threshold shift, Defense Occupational and Environmental Health Readiness System-Hearing Conservation Data Repository (DOEHRS-HC DR), United States Air Force, public health, occupational health, audiology					
<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b>  SAR	<b>18. NUMBER OF PAGES</b>  38	<b>19a. NAME OF RESPONSIBLE PERSON</b> Elizabeth Anne S. McKenna, AuD
<b>a. REPORT</b> U	<b>b. ABSTRACT</b> U	<b>c. THIS PAGE</b> U			<b>19b. TELEPHONE NUMBER (include area code)</b>

*This page intentionally left blank.*

## TABLE OF CONTENTS

	Page
LIST OF FIGURES.....	ii
LIST OF TABLES.....	iii
ACKNOWLEDGMENT.....	iv
1.0 BACKGROUND.....	1
2.0 METHODS AND METRICS .....	1
2.1 SIGNIFICANT THRESHOLD SHIFT .....	1
2.2 COMPLIANCE.....	5
2.3 AUDIOGRAM FOLLOW-UP.....	5
2.4 SIGNIFICANT THRESHOLD SHIFT AND REFERENCE DISCREPANCY .....	7
3.0 DOEHR5-HC DR STATUS .....	8
4.0 PROGRAM EVALUATION GAPS AND RECOMMENDATIONS .....	9
5.0 REFERENCES.....	12
APPENDIX: DATA FOR GRAPHS 1-10.....	13
LIST OF ABBREVIATIONS AND ACRONYMS .....	29

## LIST OF FIGURES

	Page
GRAPH 1. Positive Threshold Shift in Military .....	2
GRAPH 2. Positive Threshold Shift in Civilian .....	3
GRAPH 3. Positive Threshold Shift in Military and Civilian (Total) .....	3
GRAPH 4. STS Rate Distributed by Major Command (ACC, AETC, AFMC, AMC, PACAF, USAFE).....	4
GRAPH 5. STS Rate Distributed by Major Command (AFDW, AFGSC, AFR, AFSOC, AFSPC, ANG, USAFA) .....	4
GRAPH 6. Hearing Conservation Program Compliance with Annual Audiometric Monitoring.....	5
GRAPH 7. Follow-Up Test 1 Non-Compliance for STS Cases .....	6
GRAPH 8. Follow-Up Test 1 Non-Compliance for STS Cases Distributed by Major Command (ACC, AETC, AFMC, AMC, PACAF, USAFE) .....	6
GRAPH 9. Follow-Up Test 1 Non-Compliance for STS Cases Distributed by Major Command (AFDW, AFGSC, AFR, AFSOC, AFSPC, ANG, USAFA).....	7
GRAPH 10. Reference Discrepancy Variation with STS Rate .....	8

## LIST OF TABLES

	Page
TABLE 1. Hearing Conservation Program Business Rules .....	2
TABLE 2. Reference Discrepancy Business Rules .....	8
TABLE 3. Significant DOEHRS-HC DR System Status Changes in 2016.....	9

## ACKNOWLEDGMENT

This study was supported with Defense Health Program funds through the 711<sup>th</sup> Human Performance Wing, Wright-Patterson Air Force Base, Ohio.



## 1.0 BACKGROUND

The U.S. Air Force School of Aerospace Medicine (USAFSAM), Epidemiology Consult Service Division, Operations Support Branch (PHRO) prepares an annual status report on the Air Force Hearing Conservation Program (HCP) in accordance with Air Force Instruction (AFI) 48-127, Occupational Noise and Hearing Conservation Program,<sup>1</sup> and Department of Defense (DoD) Instruction 6055.12, Hearing Conservation Program.<sup>2</sup> This report covers calendar year 2016. Major command (MAJCOM) and installation level reports on hearing conservation metrics are available quarterly and by request from USAFSAM/PHRO.

A secondary purpose of this report is to summarize the status of the Defense Occupational and Environmental Health Readiness System-Hearing Conservation Data Repository (DOEHRS-HC DR) from the perspective of the Service functional, which is fulfilled by USAFSAM/PHRO. A third purpose is to identify current performance gaps within the HCP and provide recommendations for local unit and higher headquarters program management and evaluation of program effectiveness.

## 2.0 METHODS AND METRICS

Data for this report were gathered from the DOEHRS-HC DR Positive Threshold Shift Report by DoD and by MAJCOM, the Hearing Conservation Compliance Report by DoD, previous annual reports by USAFSAM/PHRO,<sup>1</sup> and by analysis of raw DOEHRS-HC data (specifically for reference discrepancy metrics). Access to DOEHRS-HC DR reports and DOEHRS-HC raw data is available to USAFSAM/PHRO as the functional representatives for the Air Force for this system. Per DoD 6055.12, two program metrics are required: significant threshold shift (STS) rates and audiogram completion rates. Additional metrics provided in this report include STS without follow-up tests and STS without reference discrepancies. The Appendix contains the data used to create Graphs 1-9.

### 2.1 SIGNIFICANT THRESHOLD SHIFT

STS is an average decrease of 10 dB or more at 2000, 3000, and 4000 Hz on a periodic audiogram compared to the reference audiogram for that individual.<sup>1,2</sup> Follow-up testing is required per AFI 48-127 and DoD Instruction (DoDI) 6055.12 and determines if the STS is a temporary threshold shift (TTS) that resolves on follow-up testing or a permanent threshold shift (PTS) that is confirmed on follow-up testing or lack of follow-up testing. See Table 1 for business rules in accordance with AFI 48-127. Graphs 1-3 reflect STS, TTS, and PTS rates by military personnel, federally employed civilian personnel, and total (military and civilian) personnel, respectively. Graphs 4 and 5 reflect STS rates by MAJCOM for all personnel. Data were extracted from the Positive Significant Threshold Shift by DoD report, an aggregate report available on the DOEHRS-HC DR.

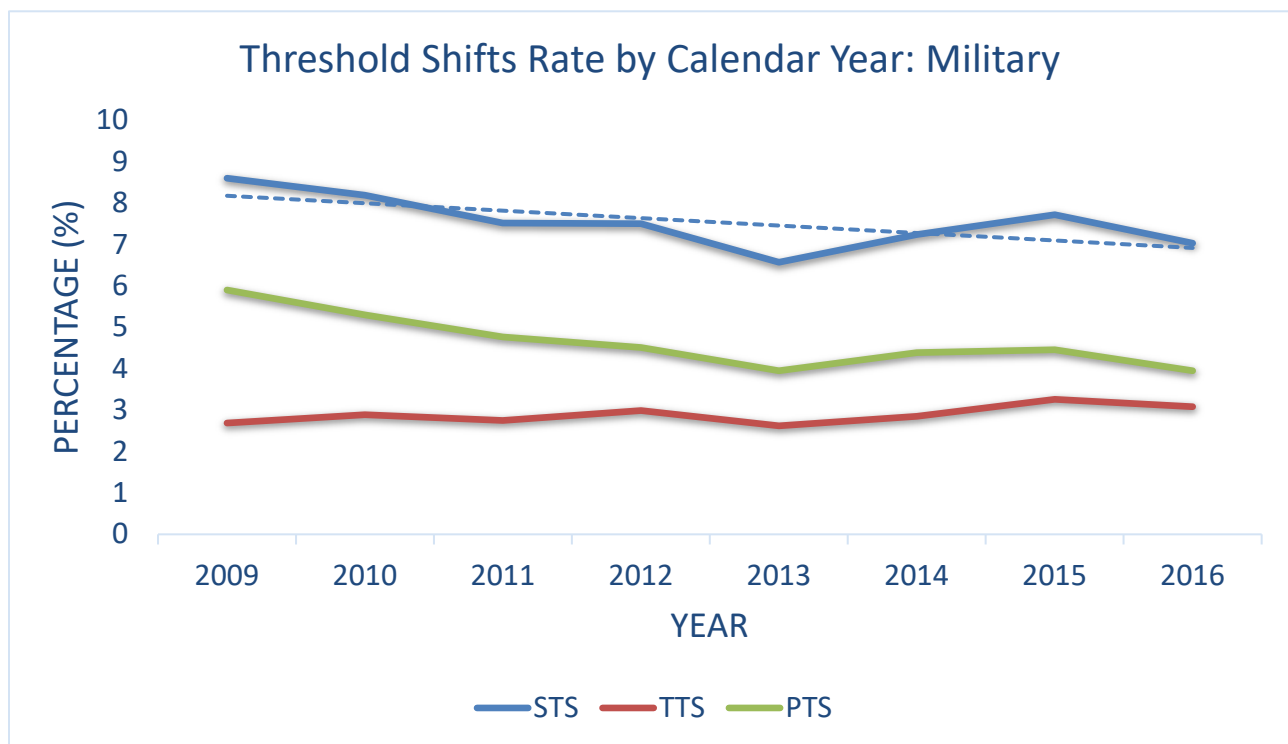
**TABLE 1. Hearing Conservation Program Business Rules**

PERIODIC EXAM	FIRST FOLLOW-UP EXAM†	SECOND FOLLOW-UP EXAM†	OUTCOME
PASS (NO SHIFT)	NOT REQUIRED	NOT REQUIRED	NO SHIFT
FAIL (POSTIVE THRESHOLD SHIFT)*	PASS	NOT REQUIRED	TTS
FAIL	FAIL	PASS	TTS
FAIL	NOT COMPLETED	NOT COMPLETED	PTS
FAIL	FAIL	NOT COMPLETED	PTS
FAIL	FAIL	FAIL	PTS

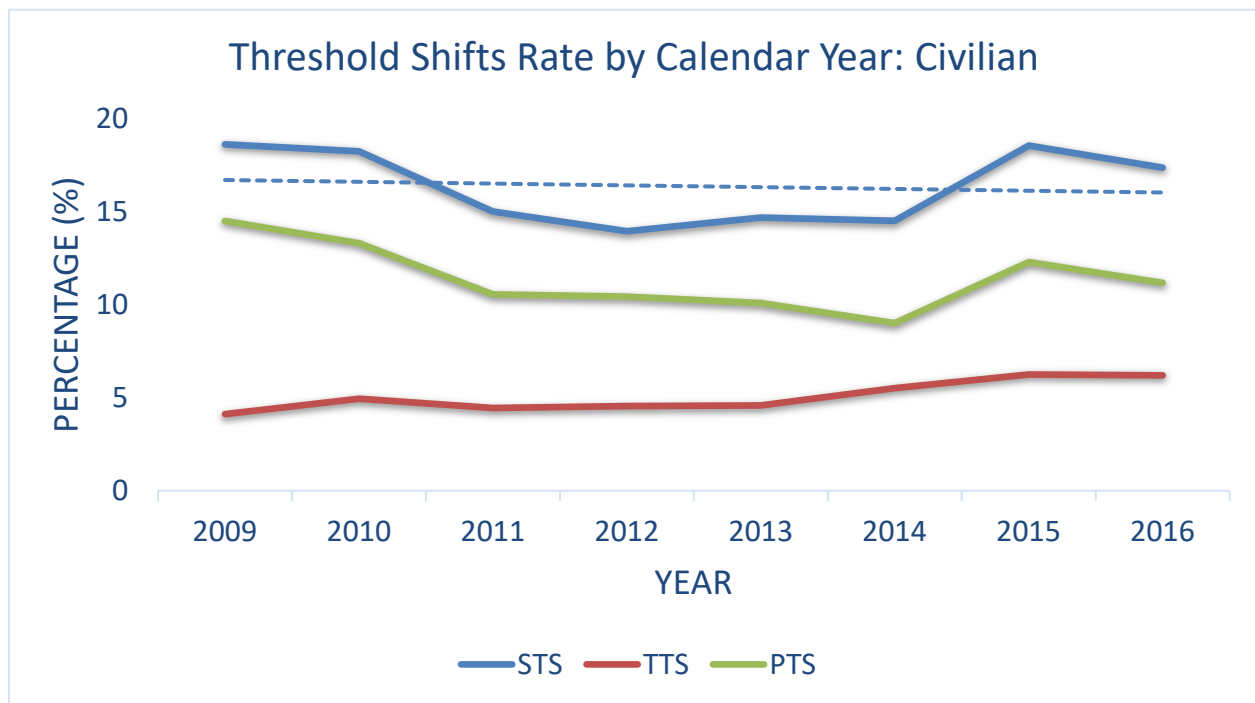
†Current follow-up period for active duty and civilian members is 30 days. Follow-up period for Air National Guard and Air Force Reserve is 60 days.

\*PTS is defined as an average increase of 10 db or more at 2000, 3000, and 4000 Hz on the periodic hearing test compared to the current reference audiogram.<sup>1,2</sup>

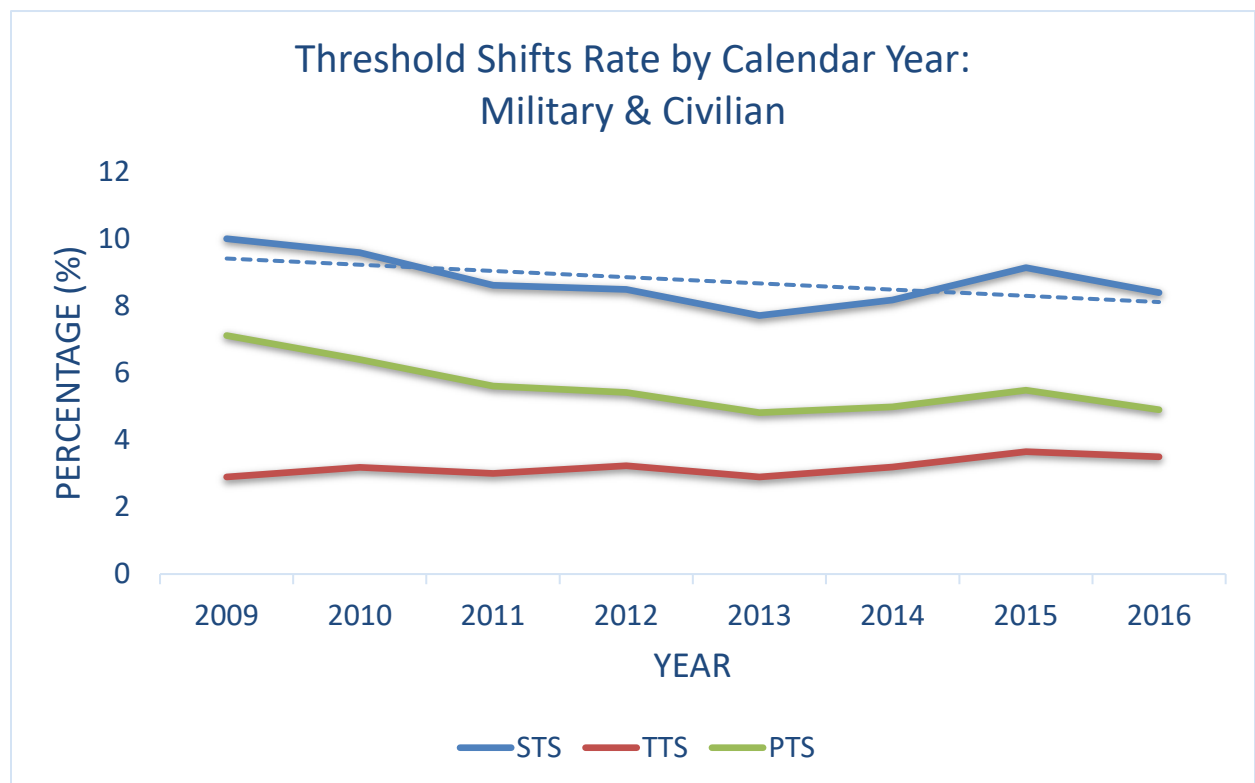
**GRAPH 1. Positive Threshold Shift in Military**



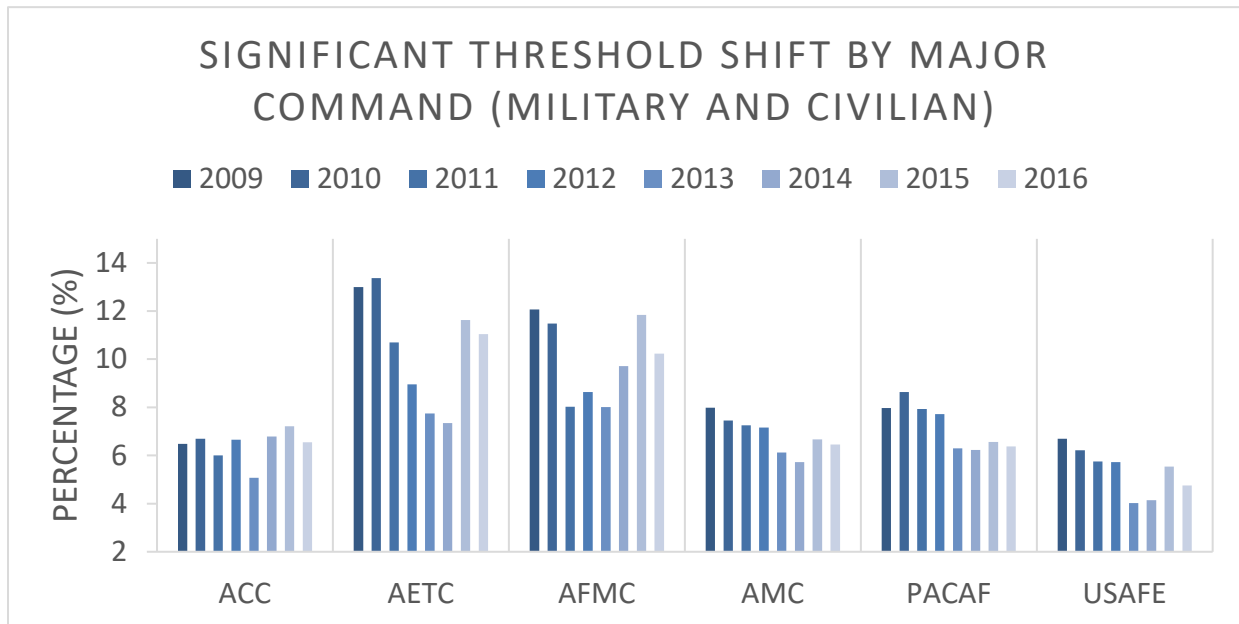
**GRAPH 2. Positive Threshold Shift in Civilian**



**GRAPH 3. Positive Threshold Shift in Military and Civilian (Total)**

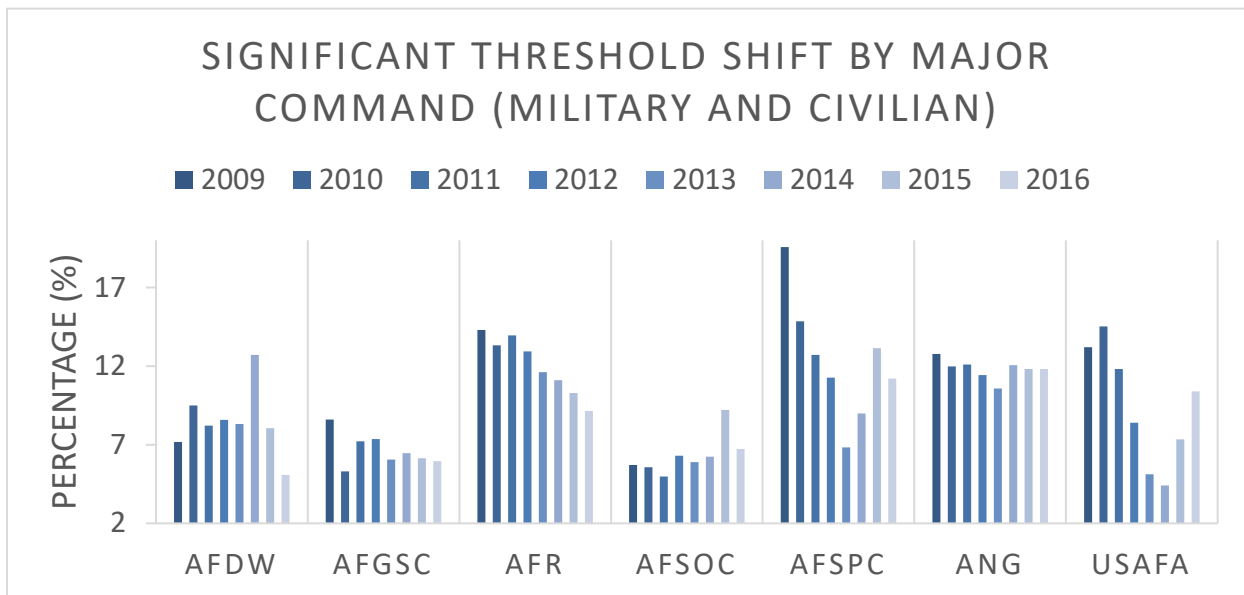


**GRAPH 4. STS Rate Distributed by Major Command (ACC, AETC, AFMC, AMC, PACAF, USAFE)**



ACC = Air Combat Command; AETC = Air Education & Training Command; AFMC = Air Force Materiel Command; AMC = Air Mobility Command; PACAF = Pacific Air Forces; USAFE = United States Air Forces in Europe

**GRAPH 5. STS Rate Distributed by Major Command (AFDW, AFGSC, AFR, AFSOC, AFSPC, ANG, USAFA)**

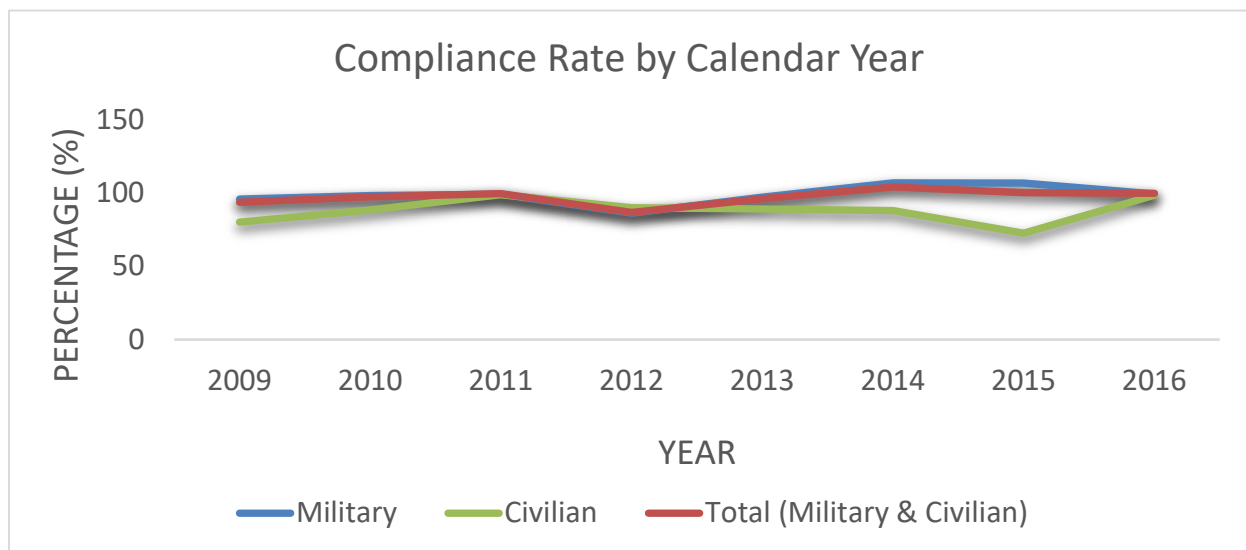


AFDW = Air Force District of Washington; AFGSC, Air Force Global Strike Command; AFR = Air Force Reserve; AFSOC = Air Force Special Operations Command; AFSPC = Air Force Space Command; ANG = Air National Guard; USAFA = United States Air Force Academy

## 2.2 COMPLIANCE

Audiogram compliance is the number of people who received a periodic audiogram (numerator) divided by the number of members requiring an audiogram (HCP enrollees). The number of periodic audiograms is collected from the DOEHS-HC DR Hearing Compliance report, and the HCP enrollees are collected in the Aeromedical Services Information Management System (ASIMS). While the numerator reflects the number of periodic tests over the year by unique individual in the DOEHS-HC data, the denominator is a snapshot in time from the date of the ASIMS data report. Therefore, the number of periodic tests is more reflective of cumulative testing activity than the number of HCP enrollees for the timeframe; in other words, some of the audiograms counted in the numerator may not belong to personnel in the denominator and vice versa. This is a limiting factor to this metric, as the data are collected from disparate databases, likely overestimating the compliance rate. Graph 6 provides the compliance rate in percentage for total (military and civilian), military and civilian.

**GRAPH 6. Hearing Conservation Program Compliance with Annual Audiometric Monitoring**

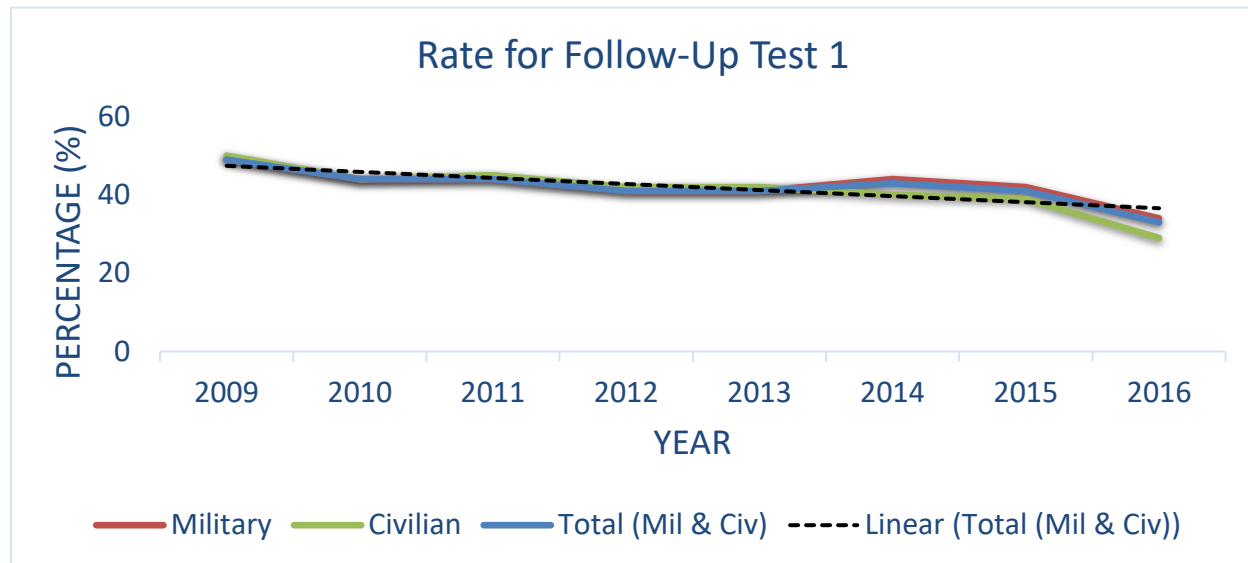


## 2.3 AUDIOGRAM FOLLOW-UP

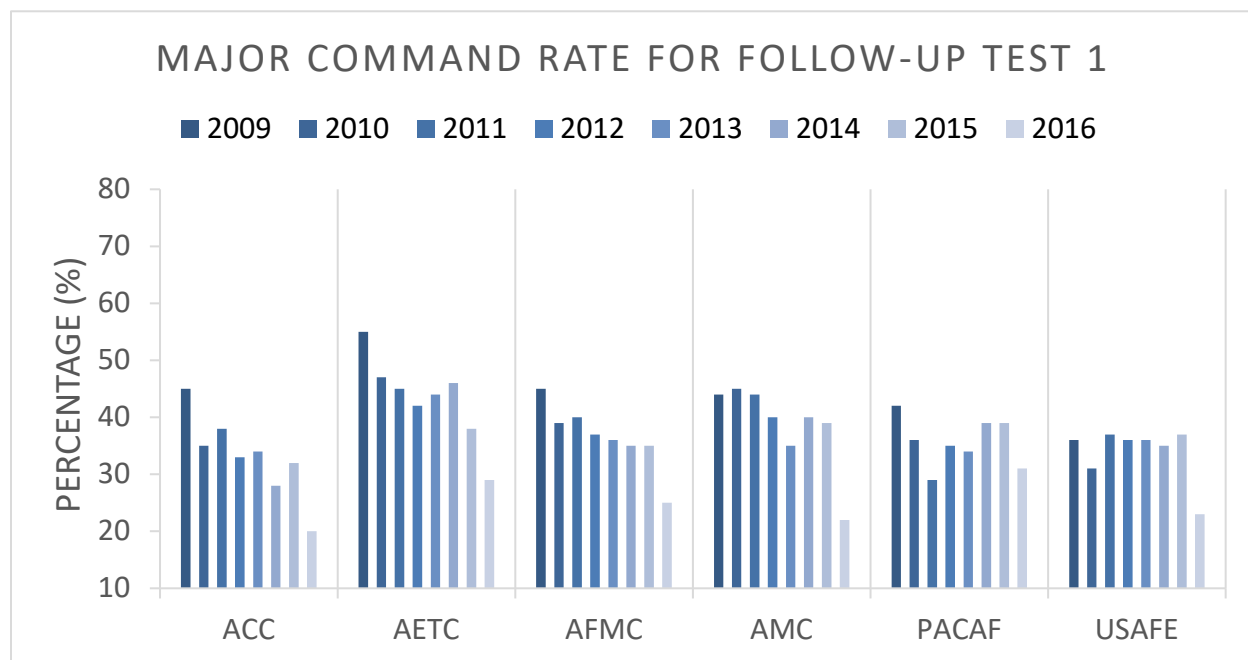
After an STS occurs, both DoDI 6055.12 and AFI 48-127 require the patient to follow up for a noise-free hearing test to provide confirmation of the STS. Follow-up tests determine whether the hearing change was temporary and determine the next patient care steps, including referral to a provider. Without follow-up tests, the final disposition of hearing status is unknown. Graph 7 provides percentage of follow-up tests for individuals with an STS on a periodic test who did not follow up within the required timeframe by calendar year. In accordance with AFI 48-127, a positive shift on a periodic test that does not receive follow-up testing within the required timeframe is considered a PTS. Graphs 8 & 9 provide percentage of follow-up test

(“test 1”) non-compliance for STS cases distributed by MAJCOM. Data were extracted from the Positive Significant Threshold Shift by DoD, an aggregate report available from the DOEHS-HC DR.

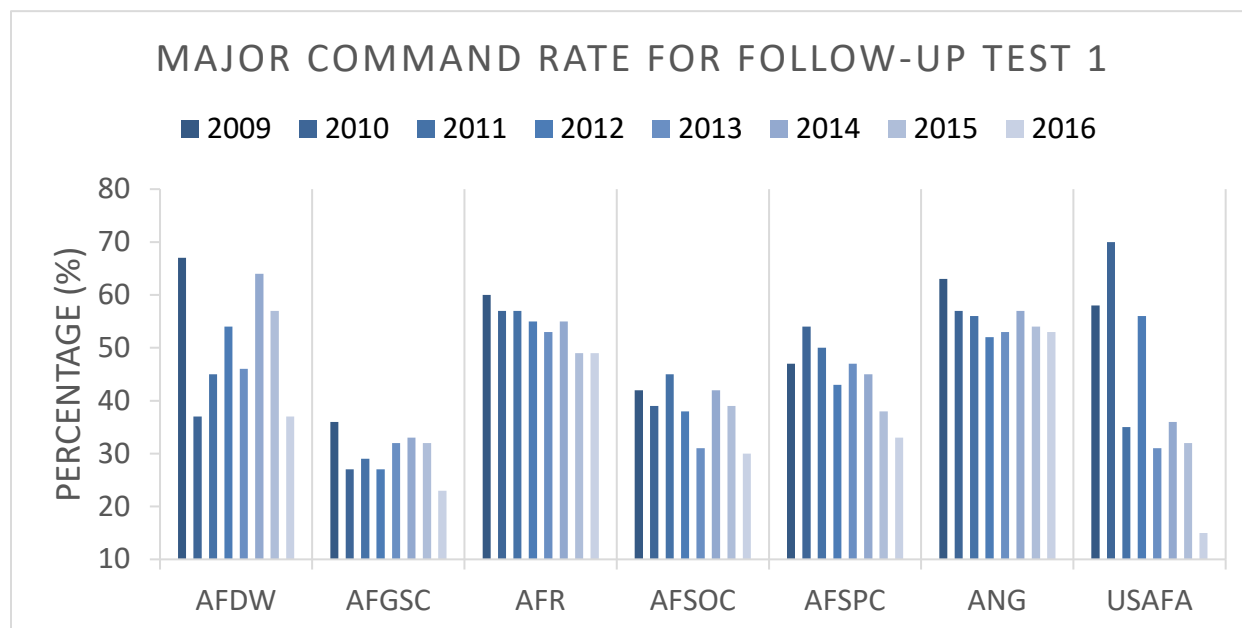
**GRAPH 7. Follow-Up Test 1 Non-Compliance for STS Cases**



**GRAPH 8. Follow-Up Test 1 Non-Compliance for STS Cases Distributed by Major Command (ACC, AETC, AFMC, AMC, PACAF, USAFE)**



**GRAPH 9. Follow-Up Test 1 Non-Compliance for STS Cases Distributed by Major Command (AFDW, AFGSC, AFR, AFSOC, AFSPC, ANG, USAFA)**



## 2.4 SIGNIFICANT THRESHOLD SHIFT AND REFERENCE DISCREPANCY

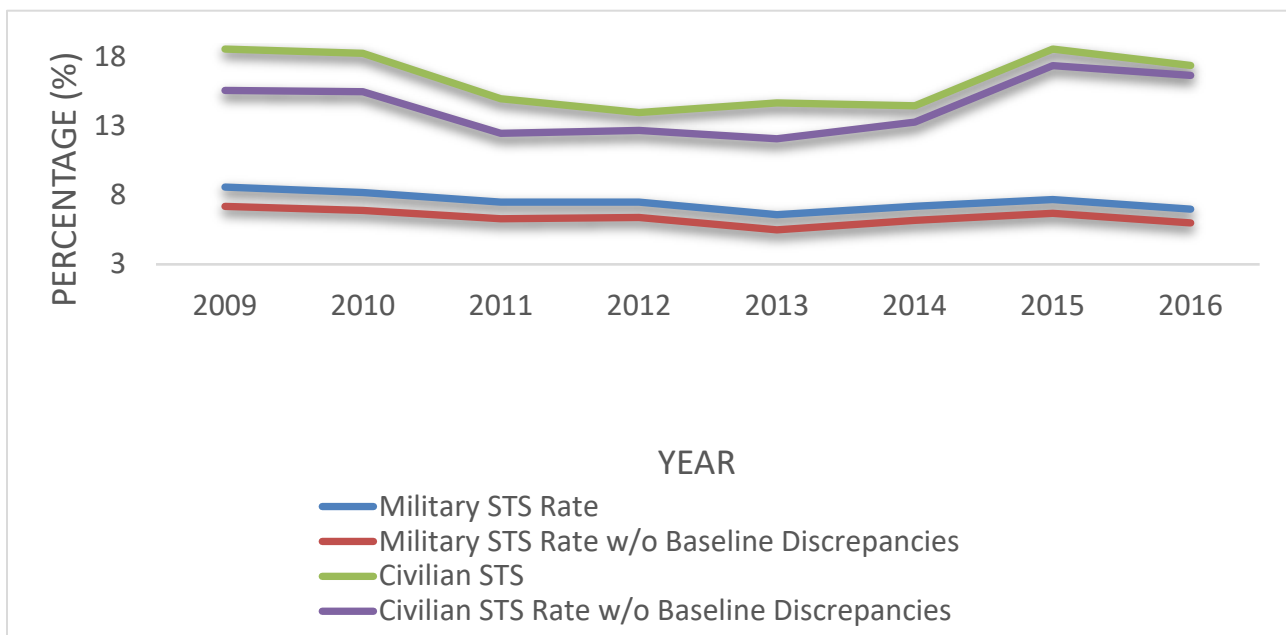
Periodically, a member will require their reference audiogram to be re-established for various reasons (Table 2, see column one, Reference Purpose Description). Per the business rules of the DOEHS-HC DR system, certain references are prioritized over others and may result in different shift outcomes than anticipated by the examiner running the hearing test. If an incorrect reason for the reference audiogram is selected at the local test installation, it will cause a discrepancy between which reference is prioritized in the DR. These discrepancies between the local testing data and the DOEHS-HC DR centralized data can cause test outcomes that affect STS and PTS rates. Table 2 summarizes the methods used in this report to find the discrepancies. This method does not take into account all possible reference discrepancies, therefore representing a conservative measure of reference discrepancies causing elevated STS and PTS rates. Graph 10 provides the variation of STS rates by calendar year with and without reference discrepancies. When reference discrepancies are accounted for, 1-1.4% of military STS cases are possibly due to incorrect reference selection either at the local level or at the DOEHS-HC DR; 0.7-3% of civilian STS cases are affected.

**TABLE 2. Reference Discrepancy Business Rules**

Reference Purpose Description*	Previous Reference Status	Outcome
Re-Established After Follow-Up Program (3)	N/A	No reference discrepancy
Change in Service Component (4)	N/A	No reference discrepancy
Prior to Initial Duty in Hazardous Noise (1)	Only reference in the DR	No reference discrepancy
Prior to Initial Duty in Hazardous Noise (1)	Previous reference on file in the DR (any type 1-4)	Reference discrepancy
Following Exposure in Hazardous Noise Duties (2)	Only reference in the DR	No reference discrepancy
Following Exposure in Hazardous Noise Duties (2)	Previous reference file in the DR (any type 1-4)	Reference discrepancy

\*DOEHRS-HC DR prioritizes reason type 3 and 4 references (Re-Established After Follow-Up Program and Change in Service Component, respectively) over type 1 and 2 references (Prior to Initial Duty in Hazardous Noise and Following Exposure in Noise Duties, respectively). When technicians are unaware of the reference sequence, periodic exams can errantly refer to an earlier reference test in the patient's records, causing STS cases in error.

**GRAPH 10. Reference Discrepancy Variation with STS Rate**



### 3.0 DOEHRs-HC DR STATUS

The function of the DOEHRs-HC DR influences hearing conservation metrics. As such, this report details major functional issues that may impact hearing tests and aggregate reporting. Table 3 summarizes the major functional impacts during calendar year 2016.



**TABLE 3. Significant DOEHRS-HC DR System Status Changes in 2016**

System	Description	Status
Air Force-wide compliance extension for DOEHRS-HC for NIPRNet	Air Force Standard Desktop Configuration mandated Windows 10 migration 64-bit cannot be used on workstations with DOEHRS-HC v4.1.2.1 due to incompatibility issues related to client application.	64-bit Exemption Memo issued 21 Jan 2016. <sup>1</sup>
Defense Manpower Data Center (DMDC)	DMDC feed of patient demographics for Air Force personnel non-functional.	Ticket entered December 2015 via the Defense Health Agency Global Service Center.
Oracle Discoverer to Microsoft Business Objects (Business Connectivity Services [BCS]) migration and access	USAFSAM functional staff accesses DOEHRS-HC DR data via a reporting tool to generate queries and reports for base level or higher headquarters surveillance and program management. Discoverer was transitioned to BCS for DOEHRS-HC DR in late 2016. However, access to either Discoverer or BCS was limited to non-functional for most of calendar year 2016.	DOEHRS-HC DR Business Objects access has been restricted since approximately November 2016.
System Change Request (SCR), System Incident Report (SIR), Maintenance Change Request (MCR)	Updates, fixes, and changes to DOEHRS-HC DR user software and data repository are completed via SCR, SIR, and MCR processes with the DOEHRS-HC Project Office.	No SCR, SIR, or MCR was completed in the reporting period. The last funded effort was November 2015.

## 4.0 PROGRAM EVALUATION GAPS AND RECOMMENDATIONS

The HCP is specified in AFI 48-127 as “a command-driven program designed to reduce or eliminate hazardous noise exposure to workers, and protect workers from the harmful effects of hazardous noise, while enhancing combat and operational capabilities.”<sup>1</sup> Audiometric monitoring is meant to measure individual hearing status to confirm that personnel are protected from the hazardous noise. Indeed, hearing test results are the key metric for health of the program.

Although DOEHRS-HC DR does provide a relatively consistent method of reporting data on hearing conservation, it does not provide an accurate measurement by which to quantify program effectiveness. There are three major areas of concern that contribute to the ambiguity of the health of the HCP: 1) inadequate handling of the data in the DOEHRS-HC DR, the system of record for hearing conservation activities; 2) inadequate data entry and quality control at the user (examiner) level for DOEHRS-HC DR; and 3) inadequate epidemiology of exposed vs. unexposed populations.

---

<sup>1</sup> Office of the Assistant Secretary of Defense Health Affairs. Memorandum for Air Force Chief Information Officer. Air Force-wide Air Force standard desktop configuration compliance extension request for DOEHRS-HC. 2016 21 Jan. [Accessed 1 Apr 2018]. Available from [https://doehrswww.apgea.army.mil/doehrsdr/secure/meta/Documents\\_input.action](https://doehrswww.apgea.army.mil/doehrsdr/secure/meta/Documents_input.action) to those with access.

First, there are a number of concerns with the DOEHRS-HC DR system that warrant discussion. Failures in record labeling include reference discrepancies found in testing sequences that do not account for all reference tests equally. This issue was described in detail in previous reports from this organization (U.S. Air Force Hearing Conservation Program, Baseline Audiogram Errors, [www.dtic.mil/docs/citations/ADA591603](http://www.dtic.mil/docs/citations/ADA591603)):<sup>3</sup>

New business rules implemented in March 2009 for DOEHRS-HC DR incorporated major changes to the software that affected the priority of DD Form 2215 Reference Audiograms (baseline tests) used during the annual test. The DOEHRS-HC DR system will give priority to reason “3 – *Re-established after Follow Up Program*” baselines over any other baseline type. In cases where no previous reason “3 – *Re-established*” exists, the system will use the earliest dated DD Form 2215 baseline audiogram (reason “1– *Prior to Initial Duty*” or “2 – *Following Exposure to Noise*”) or manually entered pre-DOEHRS baseline audiogram to determine the presence of an STS on an annual audiogram. Some annual audiograms that are “passing” (no shift) when compared with the most current available baseline in the local DOEHRS-HC system may be labeled as an STS once exported to the DOEHRS-DR system.

Legacy data from previous hearing conservation systems prior to 1997 also affect record labeling, as not all legacy hearing tests are imported and exported. Access to all previous hearing tests in the local database is critical to correct labeling of records. Program managers at all levels rely on STS, TTS, and PTS as the primary evaluation tools to determine HCP effectiveness. However, specific problems compromise the integrity of the data, making program evaluation difficult and ambiguous; reference discrepancies, as described above, artificially inflate STS, TTS, and PTS rates. Data presented in Graph 8 essentially show the maximum and minimum amounts of STS in the population by accounting for reference discrepancies, but the true STS rate more than likely lies somewhere between these two values. Therefore, it is impossible to determine true rates of change over time when performing trend analysis using DOEHRS-HC DR data directly.

Second, program management at the local unit level has a direct impact on the data trends as seen in the DOEHRS-HC DR and other USAFSAM/PHRO analyses. Lack of enforcement on follow-up tests after an STS is a significant problem within the program, as evidenced by Graphs 7-9. These unconfirmed STS cases inflate overall PTS rates, as an STS that is not investigated through the appropriate follow-up sequence will automatically convert into a PTS (Table 1). For example, Graph 1 shows all types of threshold shifts over time, but these numbers could be considered the maximum amount of shifts and not the true shift rate. As stated above, the true rates of threshold shifts are more than likely lower for all categories.

Additional program management issues include often ambiguous assignment of the installation Hearing Conservation Program Manager (HCPM), who serves as the professional supervisor of the program. This role is defined in AFI 48-127<sup>1</sup> as an audiologist, occupational medicine provider, or an experienced flight surgeon. The roles include, but are limited to, review of

patient processes and compliance, adequate protection from noise, adequacy of education to workers and supervisors, trend analysis, and oversight of fitness and risk evaluations. The role of installation HCPM is often delegated to public health technicians, which does not fulfill the intent of the AFI and is not consistent with practices in other Service components or the Occupational Safety and Health Administration (OSHA).

Audiometric monitoring is a critical component of the program, but other major program components are essential to success. Accurate data entry of patient demographics at the unit level is key to quality data from which to gauge accurate trend analysis. For example, the type and level of hazardous noise are vital to determining enrollment in the program, engineering controls for the workplace, and determining adequate hearing protection devices. Data on noise exposure and noise surveys are performed by the Bioenvironmental Flight and are stored in DOEHS Industrial Hygiene (IH). Program managers primarily utilize DOEHS-HC for program management and do not routinely have access to DOEHS-IH. DOEHS-HC DR contains limited data on noise exposure and hearing protection devices, and technicians often rely on self-report from the service member for this information, affecting quality of the information. A request for DOEHS-IH and DOEHS-HC data sharing has been initiated by the Services; however, data sharing systems still rely on the premise that accurate data are being entered by end users.

Lastly, a common misperception is that an STS is equivalent to hearing loss. However, an STS is simply a potential injury/illness marker and not a measure of type or degree of hearing loss. STS should be viewed as a potential auditory injury or illness that must be investigated to determine if actual hearing loss has occurred, as well as the extent of the potential hearing loss. As the goal of the program is to prevent noise-induced hearing loss, measures of effectiveness should include actual hearing loss metrics and not rely solely on an injury/illness marker. Currently, DOEHS-HC DR reports of hearing loss in a given population are limited to the hearing Profile Summary (H1-H3) and OSHA Reportable Hearing Loss reports. The Profile Summary report does not evaluate the hearing health in a population, but is a snapshot of the military hearing profiles. A service member can have a moderate high frequency hearing loss with an H1 profile and a mild low frequency hearing loss with an H3 profile. Due to the variation within these categories, a clear picture of hearing health within the force is not attainable using hearing profile definitions. The OSHA Reportable Hearing Loss report only identifies two of the three requirements for a reportable hearing loss, thereby overestimating the correct number of OSHA reportable cases. This report is even further limited in determining hearing health of the force, as the hearing loss severity can range from mild to profound and still meet the definition of OSHA reportable.

Based on three major areas of concern for program evaluation, the following recommendations are provided:

- 1) Submit specific changes to the DOEHS-HC DR Service Functional Working Group that would improve reference handling and reporting in the system. USAFSAM/PHRO maintains responsibility for submission and approval of changes to DOEHS-HC DR, in

conjunction with the Air Force Medical Support Agency. These recommendations may be Air Force specific and may require Service-specific funding to address. Specific changes should include, but are limited to, elimination of reference priorities that cause false STS detections, restrictions in end user data entry (through the reliance of definitive data source feeds), and updates to reporting tools to include new program effectiveness metrics (for example, early warning shift tracking). Ultimately, the investigation of a new hearing conservation system is warranted to replace DOEHRS-HC.

- 2) Identify installation HCPMs for each unit to promote ongoing surveillance communications and consultations with USAFSAM/PHRO (per AFI 48-127, section 2.16.3,<sup>1</sup> the medical treatment facility commander appoints an HCPM, which can be accomplished via an appointment letter). Stand up education plans and training courses to train and support installation HCPMs appropriately. Create self-assessment checklists to capture installation and higher level roles from AFI 48-127 requirements, with these items specifically reviewed during Unit Effectiveness Inspections.
- 3) Improve data entry at the local unit. This can be accomplished with improved education and training annually, specifically focused on the DOEHRS-HC DR system, and also limitation of data entry options by end users.
- 4) Advance measures of program effectiveness utilizing descriptive epidemiology on the DOEHRS-HC DR data, alone and in conjunction with other electronic health records, to understand the scope of occupational noise-induced illness and injury in the Air Force population. Development of meaningful measures of effectiveness and measures of performance to more accurately evaluation program effectiveness of noise-induced injuries and illnesses is necessary.

## 5.0 REFERENCES

1. U.S. Air Force. Occupational Noise and Hearing Conservation Program. Washington (DC): Department of the Air Force; 2016. Air Force Instruction 48-127. [Accessed 1 Apr 2018]. Available from [http://static.e-publishing.af.mil/production/1/af\\_sg/publication/afi48-127/afi48-127.pdf](http://static.e-publishing.af.mil/production/1/af_sg/publication/afi48-127/afi48-127.pdf).
2. Department of Defense. Hearing Conservation Program (HCP). Washington (DC): Department of Defense; 2010. Department of Defense Instruction 6055.12. [Accessed 1 Apr 2018]. Available from <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/605512p.pdf?ver=2017-10-25-110159-777>.
3. Bettano A, Koenig E, McKenna E, LeMond M. U.S. Air Force Hearing Conservation Program, baseline audiogram errors. Wright-Patterson AFB (OH): U.S. Air Force School of Aerospace Medicine; 2013. Report No. AFRL-SA-WP-SR-2013-0014. [Accessed 1 Apr 2018]. Available from [www.dtic.mil/docs/citations/ADA591603](http://www.dtic.mil/docs/citations/ADA591603).

## APPENDIX: DATA FOR GRAPHS 1-10

**Table for Graph 1. Positive Threshold Shift Rates in Military**

Periodic Audiograms	Year	STS (%)	TTS (%)	PTS (%)
140,323	2009	8.6	2.69	5.9
144,788	2010	8.19	2.89	5.3
142,885	2011	7.52	2.75	4.77
138,625	2012	7.5	2.99	4.51
143,255	2013	6.57	2.62	3.95
155,060	2014	7.24	2.85	4.39
147,807	2015	7.72	3.26	4.46
146,463	2016	7.03	3.08	3.95

**Table for Graph 2. Positive Threshold Shift in Civilian**

Periodic Audiograms	Year	STS (%)	TTS (%)	PTS (%)
23,415	2009	18.62	4.12	14.5
23,469	2010	18.25	4.94	13.31
25,097	2011	15.01	4.45	10.55
25,195	2012	13.95	4.56	10.44
23,603	2013	14.68	4.59	10.09
23,024	2014	14.52	5.52	9.01
22,370	2015	18.55	6.25	12.3
22,612	2016	17.36	6.2	11.17

**Table for Graph 3. Positive Threshold Shift in Military and Civilian**

Periodic Audiograms	Year	STS (%)	TTS (%)	PTS (%)
164,378	2009	10.01	2.90	7.12
168,964	2010	9.59	3.19	6.40
168,767	2011	8.62	3.00	5.61
163,820	2012	8.49	3.23	5.42
166,858	2013	7.72	2.90	4.82
178,084	2014	8.18	3.20	4.99
170,177	2015	9.14	3.65	5.49
169,762	2016	8.40	3.50	4.90

Table for Graphs 4 & 5. STS Rate Distributed by Major Command

2009: Military and Civilian	STS on Periodic Audiogram (%)	TTS (%)	PTS (%)
ACC	6.48	2.30	4.18
AETC	13.07	3.39	9.68
AFDW	7.17	1.42	5.75
AFGSC	8.61	3.12	5.49
AFMC	12.07	3.47	8.61
AFR	14.30	3.29	11.00
AFSOC	5.71	2.16	3.55
AFSPC	19.57	6.08	13.49
AMC	7.98	2.54	5.43
ANG	12.78	2.70	10.08
PACAF	7.97	3.06	4.91
USAFA	13.20	3.60	9.60
USAFE	6.69	2.85	3.84
<b>Grand Totals:</b>	<b>9.67</b>	<b>2.90</b>	<b>6.78</b>
2009: Military	STS on Periodic Audiogram (%)	TTS (%)	PTS (%)
ACC	5.60	2.19	3.41
AETC	9.62	2.71	6.92
AFDW	6.57	1.30	5.18
AFGSC	7.03	2.86	4.18
AFMC	8.60	3.06	5.54
AFR	14.04	3.33	10.72
AFSOC	5.39	2.13	3.26
AFSPC	16.92	6.03	10.89
AMC	7.39	2.48	4.91
ANG	12.64	2.68	9.97
PACAF	6.79	2.81	3.99
USAFA	10.66	3.46	7.20
USAFE	6.62	2.89	3.74
<b>Grand Totals:</b>	<b>8.23</b>	<b>2.67</b>	<b>5.56</b>
2009: Civilian	STS on Periodic Audiogram (%)	TTS (%)	PTS (%)
ACC	22.36	4.31	18.05
AETC	24.21	5.58	18.63
AFDW	19.05	1.90	17.14
AFGSC	27.04	6.23	20.82
AFMC	15.00	3.81	11.19
AFR	17.67	2.49	15.18
AFSOC	24.69	2.47	22.22
AFSPC	27.42	6.22	21.21
AMC	21.32	3.80	17.52
ANG	17.16	3.43	13.73
PACAF	25.80	6.63	19.17
USAFA	18.95	3.92	15.03
USAFE	17.95	2.56	15.38
<b>Grand Totals:</b>	<b>17.91</b>	<b>4.18</b>	<b>13.74</b>

<b>2010: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.72	2.92	3.80
AETC	13.37	4.29	9.08
AFDW	9.49	3.74	5.75
AFGSC	5.30	2.50	2.80
AFMC	11.48	4.00	7.48
AFR	13.33	3.23	10.09
AFSOC	5.56	2.12	3.44
AFSPC	14.85	3.81	11.04
AMC	7.45	2.49	4.96
ANG	11.99	2.96	9.03
PACAF	8.63	3.62	5.01
USAF A	14.52	2.42	12.10
USAFE	6.22	3.00	3.23
<b>Grand Totals:</b>	<b>9.21</b>	<b>3.19</b>	<b>6.03</b>
<b>2010: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.78	2.74	3.04
AETC	10.73	3.80	6.93
AFDW	9.15	3.66	5.49
AFGSC	4.44	2.33	2.11
AFMC	7.85	3.23	4.63
AFR	12.98	3.18	9.81
AFSOC	5.15	2.09	3.07
AFSPC	12.04	3.61	8.44
AMC	6.79	2.33	4.46
ANG	11.73	2.91	8.82
PACAF	7.49	3.37	4.12
USAF A	13.15	2.39	10.76
USAFE	6.16	3.05	3.12
<b>Grand Totals:</b>	<b>7.85</b>	<b>2.88</b>	<b>4.97</b>
<b>2010: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	23.62	6.26	17.36
AETC	21.72	5.78	15.93
AFDW	18.64	5.93	12.71
AFGSC	18.83	5.13	13.69
AFMC	14.66	4.67	9.99
AFR	18.32	3.92	14.41
AFSOC	23.70	4.44	19.26
AFSPC	22.81	4.20	18.61
AMC	22.54	6.05	16.49
ANG	20.26	4.96	15.30
PACAF	23.78	5.59	18.19
USAF A	17.36	2.48	14.88
USAFE	20.44	3.65	16.79
<b>Grand Totals:</b>	<b>17.33</b>	<b>4.97</b>	<b>12.36</b>

<b>2011: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.01	2.46	3.55
AETC	10.70	3.63	7.07
AFDW	8.22	2.74	5.48
AFGSC	7.21	3.08	4.13
AFMC	8.02	2.93	5.09
AFR	13.95	3.71	10.24
AFSOC	4.97	2.00	2.97
AFSPC	12.71	3.77	8.95
AMC	7.25	2.43	4.82
ANG	12.11	3.20	8.91
PACAF	7.93	4.04	3.89
USAF A	11.81	4.40	7.42
USAFE	5.75	2.79	2.96
<b>Grand Totals:</b>	<b>8.24</b>	<b>2.95</b>	<b>5.29</b>
<b>2011: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.16	2.30	2.86
AETC	7.90	2.89	5.01
AFDW	7.73	2.60	5.12
AFGSC	5.73	2.70	3.02
AFMC	4.85	1.90	2.95
AFR	13.72	3.76	9.96
AFSOC	4.75	2.02	2.73
AFSPC	9.91	3.01	6.90
AMC	6.65	2.33	4.32
ANG	11.99	3.17	8.82
PACAF	6.89	3.82	3.07
USAF A	8.33	1.59	6.75
USAFE	5.63	2.76	2.88
<b>Grand Totals:</b>	<b>7.18</b>	<b>2.68</b>	<b>4.51</b>
<b>2011: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	20.95	5.19	15.76
AETC	20.52	6.18	14.34
AFDW	22.50	6.67	15.83
AFGSC	24.81	7.71	17.11
AFMC	10.68	3.79	6.89
AFR	17.27	2.96	14.31
AFSOC	15.73	2.25	13.48
AFSPC	22.69	6.46	16.24
AMC	21.39	4.81	16.59
ANG	16.76	4.52	12.23
PACAF	21.41	6.62	14.79
USAF A	19.64	10.71	8.93
USAFE	20.86	8.63	12.23
<b>Grand Totals:</b>	<b>14.13</b>	<b>4.45</b>	<b>9.68</b>



<b>2012: Military and Civilian</b>	<b>STS on Periodic Exam (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.66	2.88	3.78
AETC	8.96	3.28	5.68
AFDW	8.59	2.50	6.09
AFGSC	7.37	3.14	4.24
AFMC	8.63	3.43	5.20
AFR	12.94	3.74	9.19
AFSOC	6.30	2.93	3.37
AFSPC	11.26	4.72	6.54
AMC	7.16	2.79	4.37
ANG	11.44	3.58	7.86
PACAF	7.72	3.55	4.17
USAF A	8.40	2.22	6.17
USAFE	5.73	2.67	3.06
<b>Grand Totals:</b>	<b>8.24</b>	<b>3.18</b>	<b>5.06</b>
<b>2012: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.68	2.71	2.97
AETC	6.21	2.73	3.48
AFDW	8.19	2.43	5.76
AFGSC	6.20	2.88	3.32
AFMC	5.78	2.43	3.35
AFR	12.69	3.76	8.94
AFSOC	5.85	2.82	3.03
AFSPC	9.73	4.31	5.43
AMC	6.53	2.64	3.90
ANG	11.37	3.61	7.76
PACAF	6.63	3.35	3.28
USAF A	5.84	1.82	4.01
USAFE	5.51	2.65	2.85
<b>Grand Totals:</b>	<b>7.19</b>	<b>2.91</b>	<b>4.27</b>
<b>2012: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	22.33	5.62	16.70
AETC	18.20	5.12	13.08
AFDW	18.33	4.17	14.17
AFGSC	22.84	6.25	16.59
AFMC	10.87	4.20	6.67
AFR	17.84	3.05	14.79
AFSOC	30.49	8.54	21.95
AFSPC	17.92	6.11	11.81
AMC	22.02	5.92	16.09
ANG	15.23	2.73	12.50
PACAF	22.69	6.41	16.28
USAF A	13.85	3.08	10.77
USAFE	16.58	3.74	12.83
<b>Grand Totals:</b>	<b>13.95</b>	<b>4.57</b>	<b>9.38</b>

<b>2013: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.07	2.30	2.77
AETC	7.74	2.81	4.93
AFDW	8.32	2.69	5.63
AFGSC	6.06	2.93	3.13
AFMC	8.01	3.06	4.94
AFR	11.62	3.72	7.90
AFSOC	5.89	3.08	2.81
AFSPC	6.83	2.36	4.47
AMC	6.13	2.78	3.34
ANG	10.58	3.35	7.22
PACAF	6.29	2.88	3.41
USAF A	5.12	2.17	2.95
USAFE	4.02	1.81	2.22
<b>Grand Totals:</b>	<b>7.27</b>	<b>2.85</b>	<b>4.41</b>
<b>2013: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	4.34	2.08	2.26
AETC	5.52	2.24	3.28
AFDW	7.79	2.52	5.27
AFGSC	5.23	2.68	2.55
AFMC	4.90	2.00	2.91
AFR	11.12	3.64	7.49
AFSOC	5.52	2.91	2.61
AFSPC	5.94	2.27	3.67
AMC	5.45	2.55	2.89
ANG	10.57	3.36	7.21
PACAF	5.25	2.73	2.52
USAF A	4.48	2.24	2.24
USAFE	3.92	1.83	2.09
<b>Grand Totals:</b>	<b>6.34</b>	<b>2.59</b>	<b>3.75</b>
<b>2013: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	17.89	5.94	11.95
AETC	15.99	4.86	11.13
AFDW	23.14	8.26	14.88
AFGSC	21.62	7.57	14.05
AFMC	10.57	3.95	6.62
AFR	21.80	5.60	16.20
AFSOC	24.79	11.57	13.22
AFSPC	11.14	2.62	8.52
AMC	21.12	7.68	13.44
ANG	15.83	3.90	11.93
PACAF	21.46	4.59	16.87
USAF A	6.62	1.99	4.64
USAFE	10.38	2.19	8.20
<b>Grand Totals:</b>	<b>13.09</b>	<b>4.47</b>	<b>8.61</b>

<b>2014: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.79	3.42	3.37
AETC	7.34	2.88	4.45
AFDW	12.71	2.99	9.73
AFGSC	6.46	3.21	3.26
AFMC	9.71	4.19	5.52
AFR	11.11	3.55	7.56
AFSOC	6.24	2.70	3.53
AFSPC	8.99	3.15	5.84
AMC	5.73	2.38	3.35
ANG	12.07	3.51	8.56
PACAF	6.23	2.72	3.50
USAF A	4.40	2.20	2.20
USAFE	4.14	1.81	2.33
<b>Grand Totals:</b>	<b>8.15</b>	<b>3.19</b>	<b>4.96</b>
<b>2014: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.88	3.15	2.73
AETC	5.24	2.45	2.78
AFDW	12.66	2.93	9.73
AFGSC	5.48	2.83	2.65
AFMC	6.94	3.01	3.93
AFR	10.76	3.53	7.23
AFSOC	5.91	2.65	3.26
AFSPC	6.65	2.30	4.35
AMC	5.16	2.24	2.93
ANG	12.08	3.52	8.55
PACAF	5.35	2.48	2.87
USAF A	2.46	1.23	1.23
USAFE	4.06	1.81	2.25
<b>Grand Totals:</b>	<b>7.23</b>	<b>2.85</b>	<b>4.38</b>
<b>2014: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	24.72	8.92	15.80
AETC	14.95	4.49	10.45
AFDW	15.84	5.94	9.90
AFGSC	23.89	9.60	14.29
AFMC	12.19	5.22	6.97
AFR	19.54	3.95	15.59
AFSOC	22.22	5.19	17.04
AFSPC	9.59	7.21	12.39
AMC	19.74	5.85	13.89
ANG	15.24	3.96	11.28
PACAF	20.76	6.24	14.52
USAF A	8.00	4.00	4.00
USAFE	9.64	2.54	7.11
<b>Grand Totals:</b>	<b>14.47</b>	<b>5.50</b>	<b>8.97</b>

<b>2015: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	7.21	3.62	3.59
AETC	11.63	4.61	7.03
AFDW	8.05	2.44	5.61
AFGSC	6.14	2.86	3.28
AFMC	11.84	4.52	7.31
AFR	10.30	3.59	6.71
AFSOC	9.22	4.03	5.18
AFSPC	13.15	5.08	8.08
AMC	6.67	3.02	3.65
ANG	11.81	3.74	8.07
PACAF	6.56	3.22	3.34
USAF A	7.34	2.70	4.63
USAFE	5.54	2.65	2.88
<b>Grand Totals:</b>	<b>8.98</b>	<b>3.64</b>	<b>5.33</b>
<b>2015: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.37	3.41	2.96
AETC	7.61	3.37	4.24
AFDW	7.71	2.34	5.37
AFGSC	5.15	2.54	2.61
AFMC	7.11	3.11	4.00
AFR	9.97	3.53	6.44
AFSOC	8.86	3.98	4.88
AFSPC	11.17	4.63	6.54
AMC	5.94	2.85	3.09
ANG	11.75	3.74	8.01
PACAF	5.73	3.03	2.69
USAF A	4.52	1.81	2.71
USAFE	5.38	2.62	2.76
<b>Grand Totals:</b>	<b>7.57</b>	<b>3.24</b>	<b>4.33</b>
<b>2015: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	24.61	8.08	16.53
AETC	25.90	9.07	16.83
AFDW	23.61	6.94	16.67
AFGSC	20.63	7.79	12.84
AFMC	15.88	5.71	10.17
AFR	17.77	4.49	13.29
AFSOC	26.61	6.45	20.16
AFSPC	21.73	7.01	14.72
AMC	23.61	6.67	16.94
ANG	15.81	4.19	11.61
PACAF	23.40	6.21	17.20
USAF A	12.37	4.30	8.06
USAFE	12.80	3.32	9.48
<b>Grand Totals:</b>	<b>18.29</b>	<b>6.25</b>	<b>12.04</b>

<b>2016: Military and Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	6.55	3.49	3.06
AETC	11.04	4.44	6.60
AFDW	5.09	2.32	2.77
AFGSC	5.96	2.85	3.11
AFMC	10.23	4.06	6.17
AFR	9.15	2.96	6.19
AFSOC	6.73	2.97	3.76
AFSPC	11.20	4.19	7.01
AMC	6.46	3.43	3.02
ANG	11.82	3.57	8.25
PACAF	6.38	3.07	3.31
USAF A	10.40	6.81	3.59
USAFE	4.76	2.41	2.35
<b>Grand Totals:</b>	<b>8.23</b>	<b>3.46</b>	<b>4.76</b>
<b>2016: Military</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	5.84	3.23	2.61
AETC	6.66	3.14	3.52
AFDW	4.73	2.19	2.54
AFGSC	4.99	2.49	2.49
AFMC	4.97	2.36	2.61
AFR	8.83	2.89	5.94
AFSOC	6.45	2.97	3.49
AFSPC	9.90	3.73	6.17
AMC	5.84	3.32	2.51
ANG	11.76	3.57	8.20
PACAF	5.58	2.86	2.72
USAF A	8.31	6.23	2.08
USAFE	4.62	2.36	2.26
<b>Grand Totals:</b>	<b>6.84</b>	<b>3.03</b>	<b>3.80</b>
<b>2016: Civilian</b>	<b>STS on Periodic Audiogram (%)</b>	<b>TTS (%)</b>	<b>PTS (%)</b>
ACC	21.74	8.83	12.91
AETC	23.74	8.17	15.57
AFDW	18.31	7.04	11.27
AFGSC	20.62	8.29	12.33
AFMC	15.36	5.71	9.66
AFR	16.23	4.39	11.84
AFSOC	19.35	3.23	16.13
AFSPC	15.69	5.62	10.07
AMC	20.24	5.77	14.47
ANG	14.57	3.59	10.99
PACAF	23.28	7.09	16.19
USAF A	14.06	7.81	6.25
USAFE	12.50	5.36	7.14
<b>Grand Totals:</b>	<b>17.16</b>	<b>6.19</b>	<b>10.98</b>

**Table for Graph 6. Hearing Conservation Program Compliance with Annual Audiometric Monitoring**

Year	Military Noise-Exposed	Military Personnel Tested	Compliance (%)	Civilian Noise-Exposed	Civilian Personnel Tested	Compliance (%)	Total Noise-Exposed	Total Personnel Tested	Compliance (%)
2009	166861	159628	95.7	32172	25748	80.0	199033	186275	93.6
2010	166736	163834	98.2	29395	25952	88.3	196131	190732	97.3
2011	160242	158703	99.0	26980	26643	98.8	187222	186348	99.6
2012	183249	157877	86.1	28749	24863	90.0	211998	183740	86.7
2013	170369	165467	97.1	27704	24675	89.1	198073	190142	96.0
2014	159180	169931	106.8	27291	23999	90.0	186471	194847	104.0
2015	150727	160844	106.7	33130	24018	72.5	183857	184862	100.1
2016	150714	151629	99.3	25122	24731	98.4	175836	176360	99.7

**Table for Graph 7. Follow-Up Test 1 Compliance for STS Cases**

Year	Military w/STS on Periodic	Military No F/U 1 Test	Military % No F/U 1 Test	Civilian w/STS on Periodic	Civilian No F/U 1 Test	Civilian % No F/U 1 Test	Total w/STS on Periodic	Total No F/U 1 Test	Total % No F/U 1 Test
2009	12235	6051	49.5	4257	2118	49.6	16528	8170	49.4
2010	12391	5508	44.6	4210	1858	44.1	16657	7365	44.2
2011	10924	4791	43.9	3586	1608	44.8	14541	6402	44.0
2012	10421	4232	40.6	3551	1503	42.3	14006	5729	40.9
2013	9387	3875	41.3	3166	1322	41.8	12583	5191	41.3
2014	11219	4976	44.4	3332	1352	40.6	14586	6329	43.4
2015	11414	4776	41.9	4127	1594	38.6	15599	6373	40.9
2016	10291	3538	34.4	3926	1143	29.1	14262	4686	32.9

**Table for Graphs 8 & 9. Follow-Up Test 1 Compliance for STS Cases Distributed by Major Command**

2009: Military and Civilian	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	1,848	831	44.97
AETC	1,415	782	55.27
AFDW	157	105	66.88
AFGSC	560	204	36.43
AFMC	3,316	1,493	45.02
AFR	1,558	928	59.56
AFSOC	278	117	42.09
AFSPC	425	199	46.82
AMC	2,059	910	44.20
ANG	1,824	1,158	63.49
PACAF	1,145	483	42.18
USAF	66	38	57.58
USAFE	658	238	36.17
<b>Grand Totals:</b>	<b>15,309</b>	<b>7,486</b>	<b>48.90</b>
2009: Military	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	1,515	641	42.31
AETC	789	449	56.91
AFDW	137	92	67.15
AFGSC	421	133	31.59
AFMC	1,079	483	44.76
AFR	1,423	837	58.82
AFSOC	258	104	40.31
AFSPC	275	131	47.64
AMC	1,828	793	43.38
ANG	1,747	1,109	63.48
PACAF	903	368	40.75
USAF	37	21	56.76
USAFE	631	223	35.34
<b>Grand Totals:</b>	<b>11,043</b>	<b>5,384</b>	<b>48.75</b>

<b>2009: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	332	189	56.93
AETC	625	334	53.44
AFDW	20	13	65.00
AFGSC	139	71	51.08
AFMC	2,236	1,014	45.35
AFR	135	94	69.63
AFSOC	20	13	65.00
AFSPC	150	69	46.00
AMC	230	119	51.74
ANG	75	48	64.00
PACAF	218	107	49.08
USAF	29	17	58.62
USAFE	21	11	52.38
<b>Grand Totals:</b>	<b>4,230</b>	<b>2,099</b>	<b>49.62</b>
<b>2010: Military and Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	2,014	707	35.10
AETC	1,437	675	46.97
AFDW	312	114	36.54
AFGSC	361	99	27.42
AFMC	3,259	1,285	39.43
AFR	1,480	840	56.76
AFSOC	341	133	39.00
AFSPC	312	169	54.17
AMC	2,147	964	44.90
ANG	1,847	1,056	57.17
PACAF	1,250	456	36.48
USAF	54	38	70.37
USAFE	615	192	31.22
<b>Grand Totals:</b>	<b>15,429</b>	<b>6,728</b>	<b>43.61</b>
<b>2010: Military</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,633	536	32.82
AETC	869	397	45.68
AFDW	290	102	35.17
AFGSC	284	74	26.06
AFMC	1,039	415	39.94
AFR	1,349	763	56.56
AFSOC	309	119	38.51
AFSPC	187	99	52.94
AMC	1,875	832	44.37
ANG	1,750	997	56.97
PACAF	1,004	356	35.46
USAF	33	23	69.70
USAFE	583	175	30.02
<b>Grand Totals:</b>	<b>11,205</b>	<b>4,888</b>	<b>43.62</b>
<b>2010: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	381	173	45.41
AETC	567	278	49.03
AFDW	22	12	54.55
AFGSC	77	25	32.47
AFMC	2,220	869	39.14
AFR	131	77	58.78
AFSOC	32	13	40.62
AFSPC	125	71	56.80
AMC	272	133	48.90
ANG	94	58	61.70
PACAF	200	96	48.00
USAF	21	15	71.43
USAFE	28	16	57.14
<b>Grand Totals:</b>	<b>4,170</b>	<b>1,836</b>	<b>44.03</b>

<b>2011: Military and Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,809	680	37.59
AETC	1,123	505	44.97
AFDW	294	132	44.90
AFGSC	494	144	29.15
AFMC	2,422	968	39.97
AFR	1,332	758	56.91
AFSOC	219	98	44.75
AFSPC	314	156	49.68
AMC	1,907	844	44.26
ANG	1,777	993	55.88
PACAF	1,029	302	29.35
USAF	43	15	34.88
USAFE	568	208	36.62
<b>Grand Totals:</b>	<b>13,331</b>	<b>5,803</b>	<b>43.53</b>
<b>2011: Military</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,459	495	33.93
AETC	638	283	44.36
AFDW	267	121	45.32
AFGSC	362	89	24.59
AFMC	668	266	39.82
AFR	1,227	692	56.40
AFSOC	205	87	42.44
AFSPC	191	100	52.36
AMC	1,680	719	42.80
ANG	1,713	955	55.75
PACAF	815	213	26.13
USAF	21	10	47.62
USAFE	533	189	35.46
<b>Grand Totals:</b>	<b>9,779</b>	<b>4,219</b>	<b>43.14</b>
<b>2011: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	347	186	53.60
AETC	485	224	46.19
AFDW	27	11	40.74
AFGSC	132	54	40.91
AFMC	1,754	702	40.02
AFR	105	69	65.71
AFSOC	14	10	71.43
AFSPC	123	56	45.53
AMC	227	125	55.07
ANG	63	37	58.73
PACAF	194	84	43.30
USAF	22	6	27.27
USAFE	29	17	58.62
<b>Grand Totals:</b>	<b>3,522</b>	<b>1,581</b>	<b>44.89</b>
<b>2012: Military and Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,922	641	33.35
AETC	993	421	42.40
AFDW	261	141	54.02
AFGSC	435	118	27.13
AFMC	2,595	965	37.19
AFR	1,144	629	54.98
AFSOC	282	106	37.59
AFSPC	296	128	43.24
AMC	1,989	795	39.97
ANG	1,804	933	51.72
PACAF	915	316	34.54
USAF	34	19	55.88
USAFE	568	202	35.56
<b>Grand Totals:</b>	<b>13,238</b>	<b>5,414</b>	<b>40.90</b>



<b>2012: Military</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,529	458	29.95
AETC	526	205	38.97
AFDW	239	128	53.56
AFGSC	340	86	25.29
AFMC	764	297	38.87
AFR	1,068	579	54.21
AFSOC	257	91	35.41
AFSPC	208	85	40.87
AMC	1,740	678	38.97
ANG	1,734	898	51.79
PACAF	720	231	32.08
USAF	16	8	50.00
USAFE	525	182	34.67
<b>Grand Totals:</b>	<b>9,666</b>	<b>3,926</b>	<b>40.62</b>
<b>2012: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	393	183	46.56
AETC	466	218	46.78
AFDW	22	13	59.09
AFGSC	95	33	34.74
AFMC	1,831	670	36.59
AFR	76	51	67.11
AFSOC	25	15	60.00
AFSPC	88	44	50.00
AMC	249	121	48.59
ANG	67	36	53.73
PACAF	177	81	45.76
USAF	18	11	61.11
USAFE	31	18	58.06
<b>Grand Totals:</b>	<b>3,538</b>	<b>1,494</b>	<b>42.23</b>
<b>2013: Military and Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,444	497	34.42
AETC	874	381	43.59
AFDW	291	135	46.39
AFGSC	441	139	31.52
AFMC	2,318	837	36.11
AFR	1,260	665	52.78
AFSOC	379	116	30.61
AFSPC	182	85	46.70
AMC	1,688	597	35.37
ANG	2,469	1,308	52.98
PACAF	847	286	33.77
USAF	26	8	30.77
USAFE	345	124	35.94
<b>Grand Totals:</b>	<b>12,564</b>	<b>5,178</b>	<b>41.21</b>
<b>2013: Military</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,163	377	32.42
AETC	485	196	40.41
AFDW	263	123	46.77
AFGSC	361	100	27.70
AFMC	641	222	34.63
AFR	1,150	607	52.78
AFSOC	349	104	29.80
AFSPC	131	59	45.04
AMC	1,435	500	34.84
ANG	2,399	1,269	52.90
PACAF	652	192	29.45
USAF	16	5	31.25
USAFE	323	109	33.75
<b>Grand Totals:</b>	<b>9,368</b>	<b>3,863</b>	<b>41.24</b>

<b>2013: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	280	127	45.36
AETC	388	187	48.20
AFDW	28	12	42.86
AFGSC	80	39	48.75
AFMC	1,676	615	36.69
AFR	109	57	52.29
AFSOC	30	12	40.00
AFSPC	51	27	52.94
AMC	253	100	39.53
ANG	69	42	60.87
PACAF	173	90	52.02
USAF	10	3	30.00
USAFE	19	13	68.42
<b>Grand Totals:</b>	<b>3,166</b>	<b>1,324</b>	<b>41.82</b>
<b>2014: Military and Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	2,048	571	27.88
AETC	771	358	46.43
AFDW	660	420	63.64
AFGSC	516	169	32.75
AFMC	2,787	984	35.31
AFR	1,342	738	54.99
AFSOC	422	179	42.42
AFSPC	220	98	44.55
AMC	1,475	594	40.27
ANG	3,030	1,722	56.83
PACAF	885	342	38.64
USAF	22	8	36.36
USAFE	393	136	34.61
<b>Grand Totals:</b>	<b>14,571</b>	<b>6,319</b>	<b>43.37</b>
<b>2014: Military</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	1,673	435	26.00
AETC	425	173	40.71
AFDW	644	415	64.44
AFGSC	414	136	32.85
AFMC	939	330	35.14
AFR	1,248	682	54.65
AFSOC	392	159	40.56
AFSPC	133	63	47.37
AMC	1,276	494	38.71
ANG	2,974	1,688	56.76
PACAF	710	261	36.76
USAF	8	3	37.50
USAFE	368	125	33.97
<b>Grand Totals:</b>	<b>11,204</b>	<b>4,964</b>	<b>44.31</b>
<b>2014: Civilian</b>	<b>STS on Periodic</b>	<b>No F/U 1 Test</b>	<b>% No F/U 1 Test</b>
ACC	374	137	36.63
AETC	346	185	53.47
AFDW	16	5	31.25
AFGSC	102	34	33.33
AFMC	1,848	658	35.61
AFR	94	57	60.64
AFSOC	30	20	66.67
AFSPC	87	34	39.08
AMC	199	101	50.75
ANG	50	30	60.00
PACAF	153	76	49.67
USAF	14	5	35.71
USAFE	19	10	52.63
<b>Grand Totals:</b>	<b>3,332</b>	<b>1,352</b>	<b>40.58</b>

2015: Military and Civilian	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	2,071	654	31.58
AETC	1,202	456	37.94
AFDW	274	156	56.93
AFGSC	459	145	31.59
AFMC	3,177	1,101	34.66
AFR	1,351	662	49.00
AFSOC	576	227	39.41
AFSPC	298	112	37.58
AMC	1,567	607	38.74
ANG	2,595	1,395	53.76
PACAF	900	347	38.56
USAF	38	12	31.58
USAFE	507	190	37.48
<b>Grand Totals:</b>	<b>15,015</b>	<b>6,064</b>	<b>40.39</b>
2015: Military	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	1,734	514	29.64
AETC	607	245	40.36
AFDW	257	145	56.42
AFGSC	361	109	30.19
AFMC	879	333	37.88
AFR	1,252	609	48.64
AFSOC	543	211	38.86
AFSPC	205	70	34.15
AMC	1,337	491	36.72
ANG	2,544	1,362	53.54
PACAF	740	261	35.27
USAF	15	3	20.00
USAFE	467	173	37.04
<b>Grand Totals:</b>	<b>10,941</b>	<b>4,526</b>	<b>41.37</b>
2015: Civilian	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	335	140	41.79
AETC	594	211	35.52
AFDW	17	11	64.71
AFGSC	98	35	35.71
AFMC	2,290	769	33.58
AFR	99	56	56.57
AFSOC	33	16	48.48
AFSPC	93	42	45.16
AMC	230	119	51.74
ANG	49	32	65.31
PACAF	132	78	59.09
USAF	23	9	39.13
USAFE	27	17	62.96
<b>Grand Totals:</b>	<b>4,020</b>	<b>1,535</b>	<b>38.18</b>
2016: Military and Civilian	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	1,905	378	19.84
AETC	1,013	296	29.22
AFDW	136	50	36.76
AFGSC	497	114	22.94
AFMC	2,940	738	25.10
AFR	967	472	48.81
AFSOC	478	145	30.33
AFSPC	222	74	33.33
AMC	1,414	315	22.28
ANG	2,660	1,407	52.89
PACAF	812	252	31.03
USAF	55	8	14.55
USAFE	437	98	22.43
<b>Grand Totals:</b>	<b>13,536</b>	<b>4,347</b>	<b>32.11</b>

2016: Military	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	1,610	302	18.76
AETC	452	131	28.98
AFDW	123	45	36.59
AFGSC	390	85	21.79
AFMC	705	178	25.25
AFR	893	437	48.94
AFSOC	448	128	28.57
AFSPC	154	50	32.47
AMC	1,224	245	20.02
ANG	2,594	1,374	52.97
PACAF	670	199	29.70
USAF	28	4	14.29
USAFE	409	93	22.74
<b>Grand Totals:</b>	<b>9,700</b>	<b>3,271</b>	<b>33.72</b>
2016: Civilian	STS on Periodic	No F/U 1 Test	% No F/U 1 Test
ACC	293	80	27.30
AETC	561	167	29.77
AFDW	13	5	38.46
AFGSC	107	29	27.10
AFMC	2,234	562	25.16
AFR	74	36	48.65
AFSOC	30	17	56.67
AFSPC	67	24	35.82
AMC	186	68	36.56
ANG	65	32	49.23
PACAF	115	44	38.26
USAF	27	4	14.81
USAFE	21	5	23.81
<b>Grand Totals:</b>	<b>3,793</b>	<b>1,073</b>	<b>28.29</b>

Table for Graph 10. Reference Discrepancy Variation with STS Rate

Year	Military STS (%)	Military STS w/o Reference Discrepancy (%)	Military Delta (%)	Civilian STS (%)	Civilian STS w/o Reference Discrepancy (%)	Civilian Delta (%)
2009	8.6	7.2	1.4	18.6	15.6	3.0
2010	8.2	6.9	1.3	18.3	15.5	2.8
2011	7.5	6.3	1.2	15.0	12.5	2.5
2012	7.5	6.4	1.1	14.0	12.7	1.3
2013	6.6	5.5	1.1	14.7	12.1	2.6
2014	7.2	6.2	1.0	14.5	13.3	1.2
2015	7.7	6.7	1.0	18.6	17.4	1.2
2016	7.0	6.0	1.0	17.4	16.7	0.7

## LIST OF ABBREVIATIONS AND ACRONYMS

<b>ACC</b>	Air Combat Command
<b>AETC</b>	Air Education and Training Command
<b>AFDW</b>	Air Force District of Washington
<b>AFGSC</b>	Air Force Global Strike Command
<b>AFI</b>	Air Force Instruction
<b>AFMC</b>	Air Force Materiel Command
<b>AFR</b>	Air Force Reserve
<b>AFSOC</b>	Air Force Special Operations Command
<b>AFSPC</b>	Air Force Space Command
<b>AMC</b>	Air Mobility Command
<b>ANG</b>	Air National Guard
<b>ASIMS</b>	Aeromedical Services Information Management System
<b>BCS</b>	Business Connectivity Service
<b>DMDC</b>	Defense Manpower Data Center
<b>DoD</b>	Department of Defense
<b>DoDI</b>	Department of Defense Instruction
<b>DOEHRS-HC DR</b>	Defense Occupational and Environmental Health Readiness System-Hearing Conservation Data Repository
<b>DOEHRS-IH</b>	Defense Occupational and Environmental Health Readiness System-Industrial Hygiene
<b>HCP</b>	Hearing Conservation Program
<b>HCPM</b>	Hearing Conservation Program Manager
<b>MAJCOM</b>	major command
<b>MCR</b>	Maintenance Change Request
<b>OSHA</b>	Occupational Safety and Health Administration
<b>PACAF</b>	Pacific Air Forces
<b>PHRO</b>	Epidemiology Consult Service, Operations Support Branch
<b>PTS</b>	permanent threshold shift

<b>SCR</b>	Service Change Request
<b>SIR</b>	System Incident Report
<b>STS</b>	significant threshold shift
<b>TTS</b>	temporary threshold shift
<b>USAFA</b>	United States Air Force Academy
<b>USAFE</b>	United States Air Forces in Europe
<b>USAFSAM</b>	U.S. Air Force School of Aerospace Medicine